

ASE417:AEROACOUSTICS

L:3 T:0 P:0 Credits:3

Course Outcomes: Through this course students should be able to

- CO1 :: Understand basic acoustic principles and governing equations.
- CO2 :: Explain sound propagation and wave transmission in various media.
- CO3 :: Apply concepts to analyze noise sources in aeroengines and propellers.
- CO4 :: Analyze linearized aerodynamic theory in aeroacoustic applications.
- CO5 :: Analyze thermoacoustic instabilities and suggest control strategies.
- CO6 :: Evaluate sound propagation in aeroengine nacelles using modeling techniques.

Unit I

BASIC ACOUSTIC PRINCIPLES : Sound and sound waves, Diffraction, Reflection, sound field, Basic acoustic principles, Acoustic terminology and definitions, Relationship between wave lengths, particle velocities, acceleration, energy density, acoustic intensity, Reference standards and measurement, Dynamics of acoustic principles, Continuity Equation, Euler's Equation, Poisson's Equation, Wave Equation

Unit II

ACOUSTIC WAVE TRANSMISSION : Propagation of sound in the atmosphere, Sound sources in moving media, Generalized Green's formula, Lighthill equation, Standing waves and standing wave apparatus, Beam width and directivity index

Unit III

AEROENGINE AND PROPELLER NOISE : Noise sources of propeller, Propeller noise prediction in frequency domain and time domain, Noise sources in aeroengine, Tone noise by rotor/stator interaction in fan/compressor, Shockwave noise in fan/compressor, Combustion noise, Jet noise

Unit IV

LINEARIZED AERODYNAMICS FOR AEROACOUSTIC APPLICATIONS : Basic linearized unsteady aerodynamic equations, Introduction to sound generation induced by vortex flow, analysis of fan/compressor cascade, Vortex sound model of trailing edge noise and liner impedance, vortex sound interaction of perforated plates

Unit V

SOUND GENERATION, PROPAGATION, AND RADIATION IN/FROM AN AEROENGINE

NACELLE : Basic theory of sound propagation in ducts, Sound propagation in an aeroengine nacelle, Fundamental idea of the transfer element method, Construction of transfer element for a varying cross-section duct, Fan noise source modelling

Unit VI

THERMOACOUSTIC INSTABILITY : Basic concepts of thermoacoustics, types of thermoacoustic instabilities, effect of thermoacoustic instabilities on aeroengine performance, One-dimensional calculation method, Three-dimensional linear combustion instability analysis method, Control of thermoacoustic instability

Text Books:

1. ELEMENTS OF AVIATION ACOUSTICS by G.J.J. RUIJGROK, YES DEE
2. AERODYNAMIC NOISE AN INTRODUCTION FOR PHYSICISTS AND ENGINEERS by TARIT BOSE, SPRINGER

References:

1. NOISE AND VIBRATION CONTROL ENGINEERING: PRINCIPLES AND APPLICATIONS by ISTVÁN L. VÉR, LEO L BERANAK, WILEY
2. FUNDAMENTALS OF AEROACOUSTICS WITH APPLICATIONS TO AEROPROPULSION SYSTEMS by XIAOFENG SUN, XIAOYU WANG, ELSEVIER

